

**METHOD AND ARRANGEMENT FOR THE PRODUCTION OF A WOOD-FREE  
COATED, MATTE OR SEMI-MATTE PAPER WEB**

**BACKGROUND OF THE INVENTION**

5    **1. Field of the invention.**

        This invention relates to a method and an arrangement for the production of a wood-free coated, matte or semi-matte paper web.

**2. Description of the related art.**

        Nowadays, wood-free coated (WFC) papers are coated once or several times and then  
10    calendered slightly or not at all. Between the gloss and the roughness of the paper there  
        exists a fixed dependency or relation which can be changed within certain, but greatly  
        restricted limits, only by manipulating the coating recipe. The finish of the paper is very  
        largely defined by the possible calendering process.

        On account of this dependency, only the production of a wood-free coated paper web  
15    with limited qualities is possible.

**SUMMARY OF THE INVENTION**

        The object of the present invention is to disclose a method and an arrangement for the  
        production of a wood-free coated paper web, which permit the production of paper webs in  
20    new quality ranges, in particular for matte and semi-matte WFC grades.

        This object is accomplished with a method according to the present invention in that  
        the paper web is precalendered by way of at least one apparatus for precalendering, then  
        coated at least on one side by way of at least one apparatus for applying a liquid or pasty  
        application medium and finally dried by at least one apparatus for drying. The result is to  
25    create a wood-free coated, matte or semi-matte paper web with a roughness level in the range  
        from 0.8 to 3.9  $\mu\text{m}$  Parker Print Surf [PPS] and a gloss value in the range from 3 to 35 %  
        [TAPPI 75°] (Technical Association of the Pulp and Paper Industry, referring to T480 a

method of dewatering Specular Gloss of Paper and Paperboard at 75°; ISO 8254-1; ASTM D1223).

This combination, according to the present invention, permits the entry into new quality ranges for WFC grades, in particular for matte and semi-matte WFC grades. Thanks to the method according to the present invention, the coated paper can be produced with less impact on its volume and the required calendering work can be significantly reduced. In particular for single-coated paper webs, meaning for non-precoated paper webs, the roughness level of the paper web after the precalendering, is less than 6  $\mu\text{m}$ , in particular less than 5  $\mu\text{m}$ , and is equal to or greater than 1.4 times the final roughness of the finished paper web. Hence the possibility of producing a paper web with a very low roughness level and a very small gloss value is provided. As such, the universally known dependency between the roughness and the gloss is greatly reduced with the new process, as the result of which the production of new paper qualities becomes possible.

Special attention is paid to the precalendering directly prior to the final application. The desired smoothness must be produced here already in order for the desired finish to be obtained after the following application, in particular by way of a non-contact curtain coating. By doing without the hitherto customary calendering after the final application it is possible to obtain the required gloss solely through the composition of the application medium. The precalendering is also very advantageous for the application, in particular by way of the non-contact curtain coating, as the requirements imposed on the viscoelasticity of the application medium are reduced as the result and a good application quality is assured.

Furthermore, the entire process for the production of wood-free coated, matte or semi-matte paper webs is simplified as the hitherto customary finishing is no longer required and the entire process can be designed preferably as an online process.

In one embodiment of the present invention the paper web is coated prior to its precalendering by way of at least one apparatus for applying liquid or pasty application

medium. The coating takes place preferably on a first side once by way of a film or curtain coating device, on both sides once by way of a film coating device or on both sides once by way of a curtain coating device. The compositions of the coating colors, the respective coating weights and the like can vary in each case. After this coating, the paper web is dried  
5 in a known manner.

Furthermore, provision can be made for the paper web to be conveyed through at least one film press prior to the first application of the liquid or pasty application medium. A possible first thickness calibration of the paper web is thus realized in an effective and simple manner.

10 In another embodiment of the present invention the paper web is precalendered by way of a smoothing unit, by way of a shoe calender with at least one extended nip and a smoothing unit, by way of a soft calender with at least one nip, or by way of a super calender with at least one nip. These apparatuses for precalendering are excellently suited for the purpose and are characterized by a level of process reliability necessary for the production  
15 process according to the present invention as well as by beneficial operating costs.

The paper web is then coated once on a first side by way of an apparatus for applying liquid or pasty application medium, in particular a curtain coating device. In addition or alternatively to this, the paper web is coated once also or only on a second side by way of a further apparatus for applying liquid or pasty application medium, in particular a curtain  
20 coating device. The composition of the at least one coating color, the coating weight and the like can vary in each case. After this coating, the paper web is dried for the first time, or again, in a known manner.

Once again provision can be made for the paper web to be conveyed through at least one film press prior to its precalendering, assuming that the paper web is coated only once. A  
25 possible first thickness calibration of the paper web is thus realized in an effective and simple manner.

An object of the present invention is accomplished with an arrangement of, in the running direction of the paper web, at least one apparatus for precalendering the paper web, at least one apparatus for applying liquid or pasty application medium onto the paper web and at least one apparatus for drying the paper web.

5           In another embodiment of the present invention at least one further apparatus for applying liquid or pasty application medium to the paper web and one further apparatus for drying the paper web are arranged, in the running direction of the paper web, upstream from the apparatus for precalendering the paper web. The apparatus for precalendering the paper web includes at least one smoothing unit, one soft calender with at least one nip, one super  
10 calender with at least one nip or one shoe calender with at least one extended nip. In this case the smoothing unit can have two hard-cast rollers, the soft calender one hard-cast roller and one roller equipped with a plastic covering, and the super calender one hard-cast roller and a paper roller, whereby said roller pairs together form a nip. Furthermore, the apparatus for applying a liquid or pasty application medium is one which works in a non-contact mode or  
15 one which makes contact with the paper web. The apparatus, working in a non-contact mode, can have a curtain coating device or a spray coating device and the apparatus making contact with the paper web utilizes a jet flow coating device or a film coating device. The apparatus for drying the paper web includes an impingement dryer and/or an IR drying unit. These drying apparatuses are excellently suited for the purpose and are characterized by a level of  
20 process reliability necessary for the production process according to the invention as well as by beneficial operating costs.

          In another embodiment of the present invention at least one film press can be arranged, in the running direction of the paper web, upstream from the apparatus for precalendering the paper web or the apparatus for applying the liquid or pasty application  
25 medium to the paper web. A possible first thickness calibration of the paper web is thus realized in an effective and simple manner.

In yet another embodiment of the present invention it is also possible for the arrangement to form a unit with a paper machine. The wood-free coated, matte or semi-matte paper web can thus be produced online and hitherto necessary process steps such as, for example, the unwinding and rewinding of the paper web during the production process are no longer necessary.

### **BRIEF DESCRIPTION OF THE DRAWINGS**

The above-mentioned and other features and advantages of this invention, and the manner of attaining them, will become more apparent and the invention will be better understood by reference to the following description of embodiments of the invention taken in conjunction with the accompanying drawings, wherein:

Fig. 1 is a schematic representation of an arrangement according to an embodiment of the present invention;

Figs. 2a and 2b are further schematic representations of two arrangements according to the present invention;

Fig. 3 is a further schematic representation of an arrangement according to the present invention; and

Fig. 4 is a roughness/gloss diagram according to the present invention.

Corresponding reference characters indicate corresponding parts throughout the several views. The exemplifications set out herein illustrate one preferred embodiment of the invention, in one form, and such exemplifications are not to be construed as limiting the scope of the invention in any manner.

### **DETAILED DESCRIPTION OF THE INVENTION**

Referring now to the drawings, and more particularly to Fig. 1, there is shown a schematic representation of an arrangement for the production of a wood-free coated,

matte or semi-matte paper web 1. A paper machine 5, for the production of the paper web 1, includes a headbox, a mesh section, a press section, a drying section and a winder, all of which are not explicitly shown. The general construction of a paper machine and its sections is described in numerous publications and is well known to those skilled in the art.

5 Arrangement 10 has, in running direction L (arrow) of paper web 1, at least one apparatus 11 for precalendering paper web 1, at least one apparatus 12 for applying a liquid or pasty application medium to paper web 1 and at least one apparatus 13 for drying paper web 1. Apparatus 11 for precalendering paper web 1 includes at least one smoothing unit, one soft calender with at least one nip, one super calender with at least one nip or one shoe  
10 calender with at least one extended nip. The smoothing unit can have two hard-cast rollers, the soft calender one hard-cast roller and one roller equipped with a plastic covering, and the super calender one hard-cast roller and a paper roller. The roller pairs together form a nip. A soft calender with several rollers is known from European patent specification EP 0 732 446 B.

15 Apparatus 12, for the applying of a liquid or pasty application medium, is one which works in a non-contact mode or one which makes contact with paper web 1.

The apparatus, working in the non-contact mode, can have a curtain coating device or a spray coating device and the apparatus making contact with the paper web a jet flow coating device or a film coating device. A curtain coating method complete with application  
20 device is known, for example, from the German publication of unexamined application DE 100 12 344 A1 and from the VOITH publication "Der DF-Coater – eine Streichtechnik der neuen Generation", Twogether - Special Edition "Systems for Finishing", Hirofumi Morita, p3326 d 03.03.

Apparatus 13, for drying paper web 1, has an impingement dryer and/or an IR drying  
25 unit. Needless to say, however, other drying systems and principles may also be used.

Apparatuses 11, 12 and 13 are shown with a bold border in the schematic representation in order to lend expression to their importance.

Thanks to arrangement 10 it is possible to perform the method of the present invention. The method is characterized in that paper web 1 is precalendered by way of at least one apparatus 11 for precalendering, then it is coated, at least on one side, by way of at least one apparatus 12 for applying the liquid or pasty application medium and which is finally dried by at least one apparatus 13 for drying in order, as the result, to create a wood-free coated, matte or semi-matte paper web 1 with a roughness level in the range from 0.8 to 3.9  $\mu\text{m}$  [PPS] and a gloss value in the range from 3 to 35 % [TAPPI 75°].

In Fig. 1 it can be clearly seen that apparatuses 11, 12 and 13, as a part of arrangement 10, form a unit with paper machine 5. Hence the process steps according to the invention take place online in the production of the wood-free coated, matte or semi-matte paper web 1.

Figs. 2a and 2b show further schematic representations of two embodiments according to the present invention. In this case at least one further apparatus 14 for applying the liquid or pasty application medium to paper web 1 and one further apparatus 15 for drying paper web 1 are arranged, in running direction L (arrow) of paper web 1, upstream from apparatus 11 for precalendering paper web 1.

Moreover, further apparatus 14, for applying the liquid or pasty application medium to paper web 1, is one which works in a non-contact mode or one which makes contact with the paper web 1 (cf. Fig. 1). It is configured preferably as a film or a curtain coating device and coats paper web 1 once on a first side S1 or once on both sides S1 and S2. The one-sided coating of paper web 1 can take place on the top or bottom side and the two-sided coating of paper web 1 can take place simultaneously (cf. Fig. 2a), in overlapping periods of time or in staggered periods of time (cf. Fig. 2b).

Apparatus 15, for drying the paper web 1, has an impingement dryer and/or an IR drying unit (cf. Fig. 1). Needless to say, however, other drying systems and principles may also be used.

At least one film press 16 of known design and mode of operation (represented by  
5 double dashed lines) for the first thickness calibration of the still uncoated paper web 1 is arranged, in running direction L (arrow) of paper web 1, upstream from apparatus 14 for applying the liquid or pasty application medium to paper web 1. Between film press 16 and apparatus 14 it is possible, of course, for further units and apparatuses of known type (represented by dashed lines) to be arranged in order to contribute to the production process  
10 for the wood-free coated, matte or semi-matte paper web 1.

Fig. 3 shows a further schematic representation of an embodiment according to the present invention.

Arrangement 10 is similar in principle to arrangement 10 in Fig. 1, to which reference is made herewith. In this case provision is made for at least one film press 17 (represented by  
15 double dashed lines) of known design and mode of operation for the possible first thickness calibration of the still uncoated paper web 1 to be arranged, in running direction L (arrow) of paper web 1, upstream from apparatus 11 for applying the liquid or pasty application medium to paper web 1. Between film press 17 and apparatus 11 it is possible for further units and apparatuses of known type (represented by dashed lines) to be arranged in order to contribute  
20 to the production process for the wood-free coated, matte or semi-matte paper web 1.

Fig. 4 is a roughness/gloss diagram according to the present invention. It is clear to see that in the prior art a distinct dependency exists between the roughness and the gloss of a paper web (dashed area). This is owed to the fact that both quality characteristics are established by only one step (postcalendering). Small gloss values with low roughness levels  
25 are not possible, which, in the case of matte paper grades, is a disadvantage.



With the method of the present invention, on the other hand, it is possible to establish small gloss values with low roughness levels. This is because the roughness is defined by the precalendering and in combination with the non-contact coating is no longer worsened. A contour coat is applied during the non-contact coating. The advantage of this is that the application medium is not pressed into the paper web during the coating process, which leads to a certain wetting of the paper web and hence to an increase in the roughness of the paper web. The gloss of the paper web is thus established independently of the calendering work through the parameters of the application medium. These parameters are, for example, the consistency, the recipe, the size and form of the pigment particles and the like.

Through the precalendering, far better conditions for the non-contact application method are created. This leads, among other things, to better coating results due to lower requirements imposed on the viscoelasticity of the application medium.

Using the process steps, according to the present invention, it is possible to produce a wood-free coated, matte or semi-matte paper web in new quality ranges. The new quality ranges lie within a triangular, preferably elliptical contour which extends in the roughness range from 0.8 to 3.9  $\mu\text{m}$  [PPS] and in the gloss range from 3 to 35 % [TAPPI 75°] and is represented in Fig. 4 in full-dashed or full-lined form.

For a clear reflection of the significance of the present invention, the quality ranges of wood-free coated paper webs, produced in accordance with the production methods known hitherto, are shown in Fig. 4. These ranges lie likewise within an elliptical contour, which however has less favorable quality values and is represented in dashed form.

In summary it is to be recorded that, by way of the present invention, a method and an arrangement for the production of a wood-free coated, matte or semi-matte paper web are created which permit the production of paper webs in new quality ranges, in particular for matte and semi-matte WFC grades.

While this invention has been described as having a preferred design, the present invention can be further modified within the spirit and scope of this disclosure. This application is therefore intended to cover any variations, uses, or adaptations of the invention using its general principles. Further, this application is intended to cover such departures  
5 from the present disclosure as come within known or customary practice in the art to which this invention pertains and which fall within the limits of the appended claims.